WISDOM IS COMMON SENSE TO AN UNCOMMON DEGREE.

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the Lineman

RURAL ELECTRIFICATION ADMINISTRATION - U.S. DEPARTMENT OF AGRICULTURE

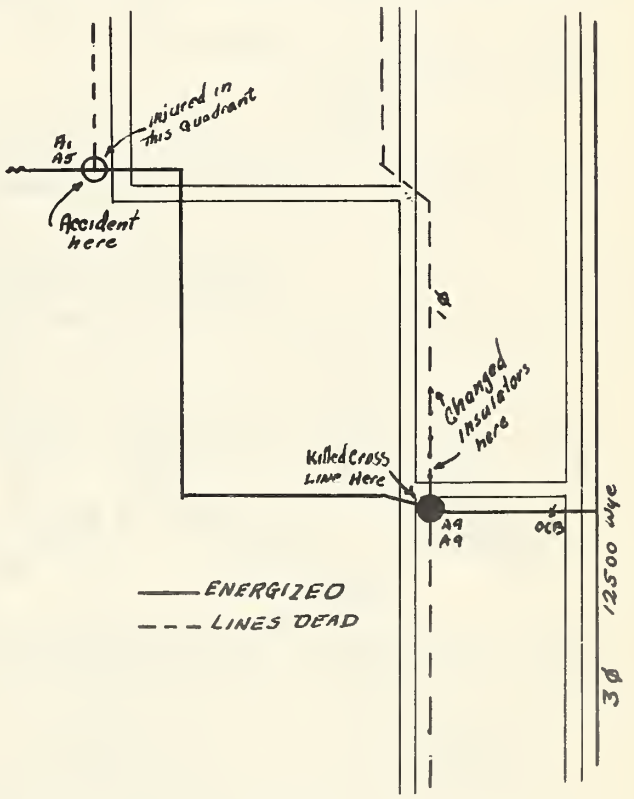
THE LINE WAS HOT--NOT DEAD

A 3-phase feeder line ran north and south along a main highway. At a crossroad, a single phase main tapped off to the west. One-half mile west of the take-off pole, the single phase line crossed another single phase line running north and south. The single phase line to the west passed under the cross line. The crossing was made by use of A9-A9 construction. The north and south single phase line was energized by jumpers from the west single phase main line.

Damaged insulators on the second and fifth poles of the cross line north of the A9-A9 crossing were to be changed. A lineman and a newly-employed groundman were assigned to the job. The lineman climbed the A-9 pole and disconnected and grounded out the cross line. This killed the cross line both ways from the A9-A9. The 3-phase feeder and the single phase main were still hot.

The last insulator to be changed out was two miles northwest of this point on the single phase main line. It was on an A1-A5 pole on this single phase line which was still hot. The A5 portion was a take-off for a short tap. This tap had been taken out of service and grounded to the neutral with the tap jumper, because of the loss of the consumer served by this tap.

It is known how the lineman, who was familiar with the lines in the area, failed to realize that in de-energizing the cross line he had done nothing to de-energize the single phase line which continued on west. Instead of removing the ground from the cross line and opening up the single phase main line, he left his grounds in place on the cross line and headed north along the cross line to a road going west. After a 2 mile's journey he reached the energized single phase line and climbed the A1-A5 pole to change out the insulator. He climbed in the northeast quadrant which placed him at the pole top with the hot single phase at his left and the disconnected tap conductor at his right. Instead of belting off immediately, he took hold of the dead tap conductor with his right hand and then grasped the energized single phase with his left hand. The electric shock which followed



made him fall backward from the pole top. In falling he struck a fence post which resulted in a broken pelvis and other internal injuries.

The left hand was burned so badly that it was amputated above the wrist. There were bad burns at the base of right palm, forefinger, ring and little finger of right hand. There was also a deep burn about five inches above the left knee.

Discussion Points:

1. Is it safe practice to assume a conductor is dead just because you think it is?

2. If the injured lineman had attempted tp ground out the line both ways from, and in sight of, the pole he was to work on would he have discovered that he had made an error and that the line was hot?

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TRANSFORMER CONNECTIONS

An understanding of what is meant by Wye (also called Star) and Delta connections is necessary to connect transformers for three-phase service. The names Wye and Delta are derived from the letter, Y, and the Greek letter Δ (Delta) which the connections can be drawn to resemble. (See figure 1)

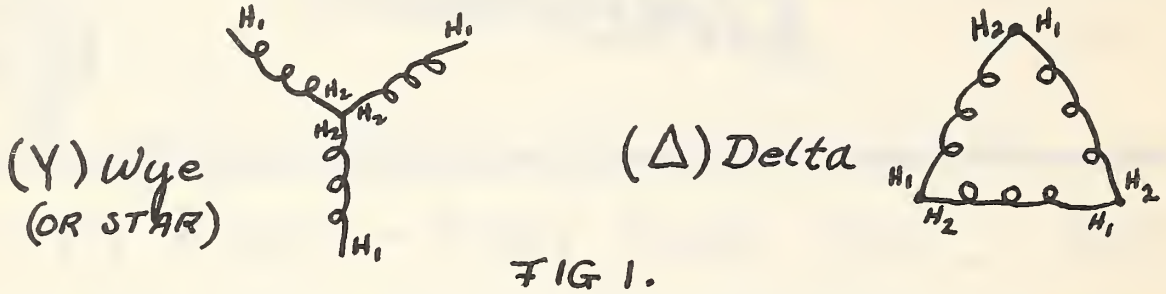

FIG 1.

High voltage coils of 3 single phase transformers Wye connected.

High voltage coils of 3 single phase transformers Delta connected.

The Wye (Y) Connection:

If the H2 terminals of three single phase transformers are connected together and each of the H1 terminals are connected to a separate phase conductor of a three phase line, the result is a Wye (Y) connection which can be sketched as shown in figure 2. The point where the H2 terminals are connected together is called the neutral.

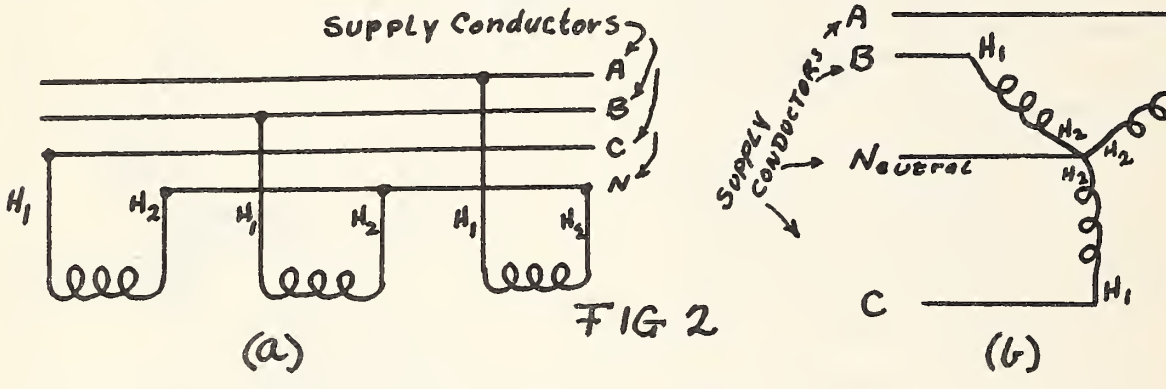

FIG 2

A and B show two methods of drawing the Wye (Y) connection for the high voltage coils of 3 single phase transformers. Note: each H2 terminal is connected to the neutral and each H1 terminal to a separate supply line.

If the X2 terminals on the low voltage side of the three single phase transformers are connected together, and each X1 terminal is connected to a separate secondary conductor the result is a Wye connection on the low voltage as well as on the high voltage side. This connection is called Wye-Wye; that is Wye on the high voltage and Wye on the low voltage side. This connection may be sketched in the two ways shown in figure 3.

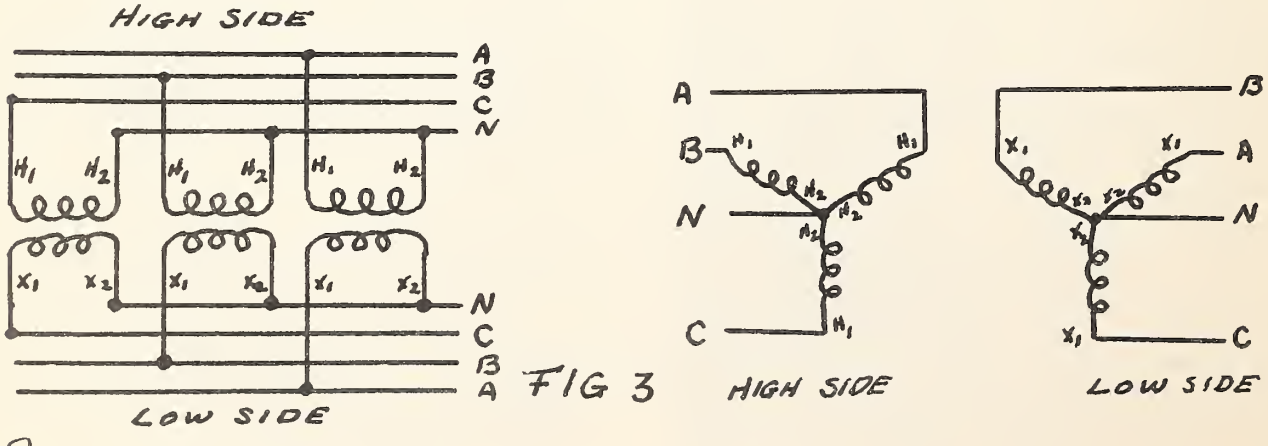

FIG 3

The Delta △ Connection:

If the H1 terminal of one single phase transformer is attached to the H2 terminal of a second transformer and the H1 terminal of the second transformer is attached to the H2 terminal of a third transformer and the circuit is closed by attaching the H1 terminal of the third transformer to the H2 terminal of the first transformer, a Delta (△) connection is formed. To connect a bank of delt-connected transformers to a 3-phase line, a phase wire is connected to each junction of the H1 and H2 terminals. This connection may be sketched as shown in figure 4.

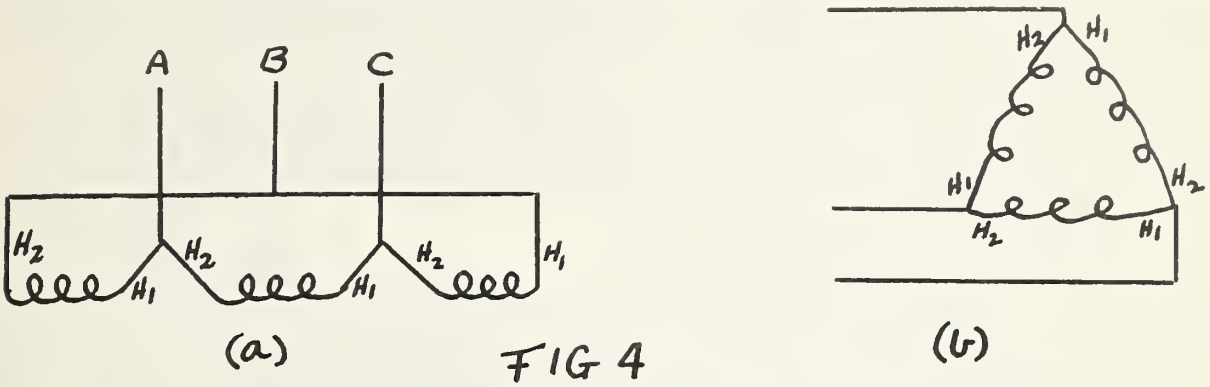

FIG 4

A and B show two methods of drawing the Delta (△) connection for the high voltage coils of 3 single phase transformers.

The low voltage side may be similarly connected in Delta by connecting the X1 terminal of the first transformer to the X2 terminal of the second, the X1 terminal of the second to the X2 terminal of the third, and the X1 terminal of the third transformer to the X2 terminal of the first. This provides a Delta-Delta (△ △) connection as shown in figure 5.

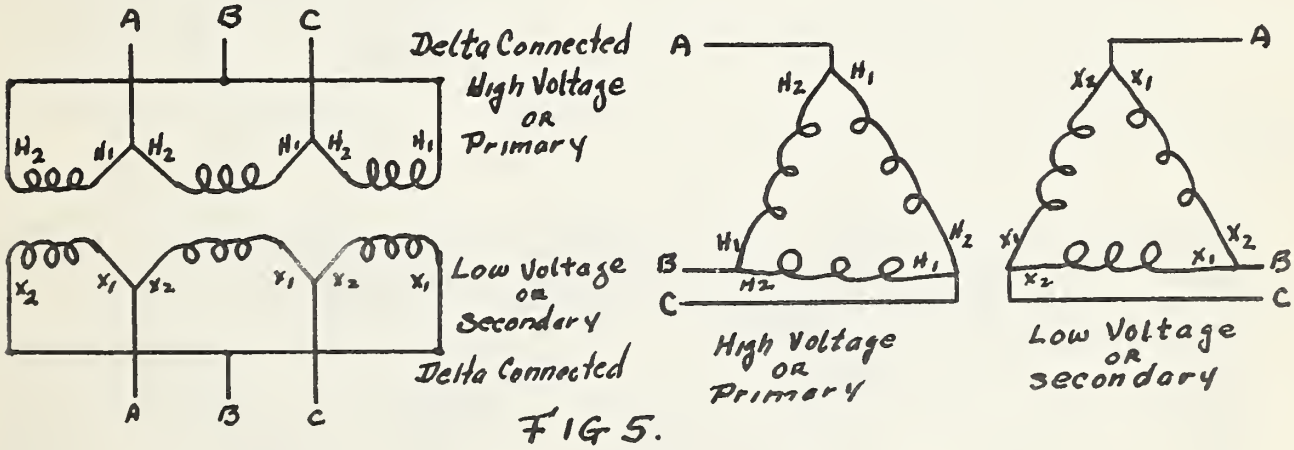

FIG 5.

Transformers may be connected with either type of connection on the high voltage side or low voltage side; such as, Wye-Delta or Delta-Wye. In connecting transformers for 3-phase operation, care should be exercised to be sure the H1,H2, X1 and X2 terminals are connected as outlined above. Otherwise an attempt to make a Delta connected secondary would result in a short circuit or an attempt to make a Wye connected secondary would result in voltages of improper phase position. Instead of being evenly spaced 120 degrees apart, one voltage would be 180 degrees out of phase, so that a 3-phase motor would not operate properly if connected to the secondary lines.

The following procedure should be used to check transformer connections after the primary connections have been made.

If the secondary is to be connected in Delta, connect what is considered the X1 terminal of the first transformer to the X2 terminal of the second transformer and the X1 terminal of the second to the X2 terminal of the third; then before connecting the X1 terminal of the third transformer to the X2 terminal of the first transformer measure the voltage between these two terminals with the transformers energized. If the voltage is approximately zero the Delta connection will be correct when the two terminals are connected together. If the voltage is approximately twice the voltage across one transformer do not complete the connection because one of the transformers is reversed.

(Continued on Next Page)

(Transformers- continued)

If the secondary is to be connected in Wye, connect what are considered the X2 terminals together. Then with the transformers energized measure the voltage between the three X1 terminals. If the voltages are equal the connection is correct. If the voltages are not equal, the two transformers with the correct voltage between their X1 terminals are correctly connected and the third transformer is reversed.

Next month we will continue with the most common connections used in rural power systems substations.

(Continued from Page 1)

3. Why would rubber gloves not have provided as good protection as protective grounds in this case?

4. Should the first act of a lineman upon reaching work position be to safety off and then check over the plans he has made to do the job?

5. In planning a job should we take precautions against the unexpected? Should we make allowance for the fact that none of us is perfect - that we have 'off days' and do not think or perform to the best of our ability? Will protective devices protect us from these oversights?

6. Is there any job a rural lineman is called upon to do which cannot be done safely, if it is properly planned and suitable protective devices and safe work proceedures used?

ANOTHER GOOD NO-ACCIDENT RECORD

We wish to thank Manager C. H. Foster of Rock County Electric Cooperative, Janesville, Wisconsin, for his favorable comments on The Lineman. In turn we wish to congratulate his employees on their record of not having a lost time accident on their cooperative since 1939. Mr. Foster states that one way of preventing accidents is to consider that the only wire not dangerous is the wire in the warehouse.

The Lineman is published monthly in the interest of safety for employees of REA-financed systems. Ralph A.C. Hill, Editor; Frank H. La Master, Associate Editor.
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New Mexico Sets Up Training and Safety Organization

Pictured setting up state organization of job training and safety in New Mexico at Roswell, N. M., recently are (l. to r.) REA Safety Engineer Jack Shehee; State Supervisor of Trade and Industrial Education Henry Gonzales; Director of T. and I. Education John Haberal; Dr. Edward Eyring, president of Highland University; and REA Labor Relations and Safety Specialist Ralph A. C. Hill.